Site Selection and Technology Evaluation for Pilot Demonstrations in the Arsenic Water Technology Partnership Program

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As part of the Arsenic Water Technology Partnership program, Sandia National Laboratories will carry out field demonstration testing of innovative technologies that have the potential to substantially reduce the costs associated with arsenic removal from drinking water. The scope for this work includes:

1) selection of sites for pilot demonstrations,
2) identification of candidate technologies through Vendor Forums, proof-of-principle bench-scale studies managed by the American Water Works Association Research Foundation (AwwaRF) or the WERC design contest, and
3) pilot-scale studies involving side-by-side tests of innovative technologies.

The goal of site selection is identification of a suite of sites that exhibit a sufficiently wide range of groundwater chemistries to allow examination of treatment processes and systems under conditions that are relevant to different geochemical settings throughout the country. A number of candidate sites have been identified through reviews of groundwater quality databases, conference proceedings and discussions with state and local officials. These include sites in New Mexico, Arizona, Colorado, Oklahoma, Illinois, Michigan, Florida, Massachusetts and New Hampshire. In New Mexico, discussions have been held with water utility board staffs in Chama, Jemez Pueblo, Placitas, Socorro and several communities near Las Cruces to determine the suitability of those communities for pilot studies. The initial pilot studies will be carried at Socorro and Jemez Pueblo; other communities will be included as the program progresses. The proposed pilot test at a hot spring water source near Socorro will provide an opportunity to test treatment technologies at relatively high temperatures. If approved by the Tribal Government, the proposed pilot at the Jemez Pueblo would provide an opportunity to test technologies that will remove arsenic in the presence of relatively high concentrations of iron and manganese while leaving the beneficial levels of fluoride unchanged.

Candidate technologies for the pilot tests are being reviewed by technical evaluation teams. The initial reviews will consider as many potential technologies and screen out unsuitable ones by considering data from past performance testing, expected costs, complexity of operation and maturity of the technology. The pilot test configurations will depend on the site-specific conditions such as access, power availability, waste disposal options and availability of permanent structures to house the test.

Most of the treatment technologies that will be evaluated can be separated into two broad categories: 1) sorption processes that use fixed bed adsorbents and 2) membrane processes. The latter include processes that involve formation of a floc or precipitate that contains the arsenic in a reactor followed by separation of the solids from the water by filtration. Several innovations that could lead to lower treatment costs have been proposed for adsorptive media systems. These include: 1) higher capacity and selectivity using mixed oxides composed of iron and other transition metals, titanium and zirconium based oxides, or mixed resin-metal oxides composite media, 2) improved durability of virgin media and greater chemical stability of the spent media, and 3) use of inexpensive natural or recycled materials with a coating that has a high affinity for arsenic. Improvements to filtration-based treatment systems include: 1) enhanced coagulation with iron compounds or polyelectrolytes and 2) improved filtration with nanocomposite materials.

In the pilot tests, the innovative technologies will be evaluated in terms of

1) their ability to reduce arsenic to levels below the EPA Maximum Contaminant Level (MCL) of 10 ppb,
2) site-specific adsorptive capacity, robustness of performance with respect to likely changes in water quality parameters including pH, TDS, foulants such as Fe, Mn, silica, and organics, effect of competing ions such as other metals and radionuclides, and potentially deleterious effects on the water system such as pipe corrosion from low pH levels, fluoride removal, and generation of disinfection by-products.

The new arsenic MCL will result in modification of many rural water systems that otherwise would not require treatment. Opportunities for improvement of water quality in systems that currently do not comply with other standards would be an added benefit from the new arsenic MCL that has both economic and public health value.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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